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NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

MOBILE DENTAL UNITS AT THE DECKPLATE

by

Peter G. Wish

March 2001

Thesis Advisor: William Gates
Co-Advisor: James Scaramozzino

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20010328 052

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** March 2001	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE: Title (Mix case letters) Mobile Dental Units at the Deckplate			**5. FUNDING NUMBERS**
6. AUTHOR(S) Peter G. Wish			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			**10. SPONSORING / MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release: distribution is unlimited.			**12b. DISTRIBUTION CODE**

ABSTRACT (maximum 200 words)

The concept of bringing dental care to the active duty member can be traced back as far as World War I. More than 80 years later, this still holds true. Today, Mobile Dental Units (MDU) seek out the patient, saving hundreds and thousands of man-hours which would otherwise be consumed by patients traveling to a point where their needs could be met. The goal of this research project is to determine the optimal number of MDUs to meet the demands of the force they support. The site chosen for this analysis was Naval Dental Center, Southwest, in San Diego, Ca. This command was chosen because it is the largest dental command within Navy medicine; it has a fleet of MDUs, four of which are used to service local squadrons, Fleet Marine Force units and approximately 30 ships of the Pacific Fleet; and it is close to the Naval Postgraduate School.

In answering this question, a Cost Benefit Analysis and Cost Effectiveness Analysis were conducted, looking at fourteen months of MDU workload. The Cost Benefit Analysis showed a savings over ten years between $467,409 and $837,754 per MDU. Five metrics were created to determine cost effectiveness. This analysis identified areas for additional potential savings, ultimately saving DoD more money and making the MDUs more productive. Considering the implications of both the cost benefit and cost effectiveness analysis, the optimal number of MDUs for Naval Dental Clinic Southwest (NDCSW) is four

Although man-hour savings is a key determinant in using these valuable assets, these vehicles more importantly improve the dental health of our operational forces, increasing Operational Dental Readiness and improving our military's overall state of Operational Readiness. More importantly, these mobile units assist the Dental Corps and BUMED with the ultimate goal of ensuring "Dentally Healthy Sailors and Marines."

14. SUBJECT TERMS Utilization, Requirements Determination, Special Studies			**15. NUMBER OF PAGES** 64
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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MOBILE DENTAL UNITS AT THE DECKPLATE

Peter G. Wish
Lieutenant, United States Navy
B.A., Troy State University 1993

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 2001

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James Scaramozzino, Co-Advisor

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Reuben Harris, Dean
Graduate School of Business and Public Policy

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ACKNOWLEDGMENTS

I would like to take this opportunity to thank the following individuals and organizations that without their help this thesis would not have been possible. Professor William Gates and CAPT James Scaramozzino from the Naval Postgraduate School. They were both instrumental in the completion of this project. The countless hours they spent with me were invaluable in formulating the methodology for this thesis and the numerous revisions needed before completion. CAPT Joseph Draude at MED 06B. The CAPT was extremely helpful in providing me with insight regarding the Dental Corps and current BUMED dental policies. CAPT Chuck Spann at the Navy Medicine Center for Organizational Development (NMCOD). CAPT Spann provided needed insight regarding a course of action when I first started this project. CDR Greg Watford and his staff at the Fleet Liaison Department of Naval Dental Center, Southwest in San Diego, Ca. During my site visit and numerous phone calls and emails, the CDR and his staff were extremely supportive. Without their support and providing me the data, this thesis would not have been possible. DT1 Michael Fortier at MED 06. DT1 Fortier was instrumental in completion of this assignment. He provided me with a variety of information regarding MDUs and for that I am eternally grateful. I also want to thank Ms. June Danis at NAVMEDLOGCOM and Mr. Glen Wingert at PWC at Naval Base San Diego. They were both extremely helpful in assisting me with gathering information about the procurement and repair of MDUs.

I. INTRODUCTION

The operational tempo (OPTEMPO) of the Armed Forces of the United States is higher today than at any other time in recent memory. A Wall Street Journal article dated September 22nd, 1999 titled "Of Men and Money, And How the Pentagon Often Wastes Both" by Greg Jaffe and Thomas E. Ricks states,

> that since 1989, the U.S. military has participated in more than 90 operations throughout the world. More than half involved substantial troop deployments for combat missions, peace-keeping assignments and humanitarian undertakings. (Jaffe and Ricks, Section A. p. 1, Column 6)

Service members today are required to be more than war fighters, they are: policemen, disaster responders and peacekeepers. This increased OPTEMPO comes at a time when military budgets are continually being scrutinized and our armed forces are required to do more with less and combat a growing consensus in our society that there is no direct threat to the security of the United States. These new roles are also being accomplished during a period when recruitment and retention are down, platforms are deploying with less than required manpower levels and each individual is critical to the mission and each unit's level of readiness.

There are four elements or pillars which the Pentagon considers integral to the capability of our military forces. They are: force structure, modernization, sustainability and readiness. A critical factor of OPTEMPO is readiness. Today, readiness is considered one of the single most important factors in dealing with military capability. Readiness is defined by the Joint Chiefs of Staff (JCS) as the ability of forces to deploy quickly and perform initially in wartime as they were designed to do.

Military forces must be ready and capable of deploying quickly. A leading cause of decreased unit readiness during the Vietnam War was Non Combat Casualties (NCC). Non Combat Casualties or Non Battle Casualties (NBC) are defined as persons who are not battle casualties, but are lost to their organization because of disease or injury, including persons dying from disease or injury, or because they are missing, where the absence does not appear to be voluntary or due to enemy action (United States Combat Casualty Digest, 2000). During Vietnam, dental related problems accounted for 20% of NCCs/NBCs.

The Dental Corps, within the Bureau of Medicine and Surgery (BUMED), is responsible for the dental care of all Department of Navy (DON) personnel. This care is delivered through a myriad of delivery systems, including: Naval Hospitals, Naval Dental Centers (NDCs), Branch Dental Clinics (BDCs), Dental Battalions and Mobile Dental Units (MDU's). An MDU is a recreational-type vehicle outfitted with dental chairs and x-ray equipment. MDU's are fully operational dental facilities capable of performing dental examinations, preventive dentistry and selective restorative procedures. MDUs are also self-contained and require no outside power. These health care delivery systems are distributed to military bases throughout the continental United States (CONUS) and outside the continental United States (OCONUS).

The Dental Corps' primary mission is to develop, direct, and evaluate dental health care policies and treatment programs, to promote and safeguard the dental health of its beneficiaries, to provide adequate dental resources and trained personnel to meet Navy and Marine Corps operational needs, and to monitor the funding and execution of DON dental programs. This is more commonly known as the state of Operational Dental

Readiness (ODR). This provides Commanding Officers with a tool to track and identify unit personnel that do not meet the minimum prescribed guidelines of eighty- five percent in dental classifications 1 and 2. Dental classifications were created by the Department of Defense (DoD) to determine the oral health status and urgency of care required for each active duty member. Dental classifications and classes also assist in measuring each unit's state of ODR. There are four dental classifications. They are:

- Class 1: Individual does not require treatment
- Class 2: Patient requires care but there is low risk of a dental emergency and treatment can be deferred due to other priorities for up to twelve months
- Class 3: Patient requires urgent care and has a high risk of dental emergency at any time
- Class 4: The oral condition of the individual is unknown

To assist deployable units in achieving this standard, MDUs were established and assigned to NDCs where large contingents of operational forces are stationed. Classes 3 and 4 are considered non deployable and negatively affect a unit's level of operational readiness. The Dental Corps first utilized MDU's in the early 1990's. NDCSW requested its first MDU in August of 1988.

MDUs are expensive and therefore need to be distributed effectively to optimize their usage and continue to meet the increased operational tempo of Navy and Marine operational forces. This thesis looks specifically at Naval Dental Center, South West, in San Diego, CA and through a cost benefit analysis and cost effectiveness analysis will determine and recommend the optimal number of MDUs for that region and where they should be placed. The analysis will look at the workload from four MDUs at NDCSW. Combined, over fourteen months worth of MDU workload has been collected. This

thesis will only consider the four core competencies that the MDUs provide. The competencies are: annual exams, cleanings, operative dentistry (fillings) and x-rays. These four competencies are the most critical in improving a unit's state of operational readiness, explaining why the MDUs are stocked to treat them. This analysis will also look at time saved by returning Sailors and Marines to work more quickly and the monetary savings that result from increased productivity and reduced time away from the ship.

NDCSW was chosen because it has five MDUs and is centrally located with the Pacific Fleet. NDCSW's fifth MDU was not included in this research project. It is permanently assigned to the LeMoore, CA geographical area, where it supports the flight line. NDCSW serves approximately forty five thousand active duty personnel. The MDUs of NDCSW primarily service approximately 30 ships, with a combined complement of approximately nine thousand personnel. They also support local squadrons and Marine Corps personnel from the Marine Corps Air Station (MCAS) in Mirimar, Ca. The majority of the ships that MDUs support do not have dental officers on board.

II. LITERARY REVIEW

A. ENVIRONMENT

Today more than ever before, the military is a growing concern. Issues such as potential threats, capability, readiness and size of force are at the forefront of our civilian leader's minds and in the newspaper headlines. This issue was discussed in a November 1999 Wall Street Journal article entitled, "Military Must Change For 21st Century – The Question is How," by Thomas E. Ricks. The article presents three different perspectives of the type of military we will need in the twenty first century from three different experts in the field. The perspectives are: the terminator, peacekeeping globocop and the insurance force.

One issue of concern is trying to determine the type of threat and its possible implications. In the past, the threat was obvious: communism. Most agree that the military needs to modernize to become state of the art. However, many feel that no country currently presents a clear threat to the U.S. Rick's states, "many predict there won't be any more big wars – just a plethora of enemy 'ankle-biters' menacing U.S. troops with nettlesome firefights, as Americans feed starving refugees on one block while separating warring factions on the next." Rick's also goes on to state,

> there is growing agreement that despite spending $275 billion annually, the U.S. military is not preparing for the battles of tomorrow. This is compounded by the fact that the military cannot attract the recruits needed to meet its goals and yet it uses labor inefficiently. Countries that many feel could pose a potential threat in the future are: China, North Korea and India. The Middle East is always a concern and will continue to be as we move further into the twenty first century. This directly affects the type and size of military we need. (Ricks, Section A. p. 1. Column 6)

Whatever the final decision regarding the type of military the U.S. needs, we must have a high state of readiness. A report to Congress prepared by the Office of the Assistant Secretary of Defense for Reserve Affairs dated 10 November 1999 states, "Dental diseases have historically accounted for 20% of non-combat injuries." Dental emergencies can impact the combat effectiveness of individuals and units. The loss of members to disease or injury can be detrimental and affect the unit's ability to accomplish its wartime mission. Dental readiness depends on the dental health of military personnel. Mobile Dental Units play an important role in maintaining Operational Dental Readiness (ODR) and help to ensure an effective fighting force. The research for this thesis will address these two areas: MDUs and ODR.

We live in an era where information technology has changed the way we gather data. Entering the twenty first century, information can be accessed instantaneously from anywhere in the world using the Internet. The task is not so much to find the data but narrowing it down and making it manageable.

In researching this topic, I utilized a variety of resources to find out anything and everything about these two topics. They included: the Internet, search engines, library data bases, military directives, newspaper articles, restricted data bases, site visits, interviews, telephone conversations and data from MED 06, NAVMEDLOGCOM, PWC and NDCSW. MED 06, is the organization within BUMED that is ultimately responsible for the dental care of Navy and Marine Corps personnel. NDCSW is the command I visited to observe MDUs in action.

To find out if any similar analyses had been conducted previously, I contacted and visited websites from the RAND Corporation, Naval Center for Cost Analysis and the Institute for Defense Analyses (IDA). None of them provided me with information or studies regarding this particular topic.

B. BACKGROUND

1. Operational Dental Readiness

MDUs are critical if operational units are going to obtain the minimum required state of dental readiness before they deploy. They also play an important role in maintaining the dental health of Marines and Sailors. SECNAVINST 6600.5, DENTAL HEALTH AND READINESS, was released in May of 1995 requiring Navy and Marine Corps commands to achieve a minimum ODR level of 85%. That level recently increased when the Department of Defense Health Affairs, DoD(HA), raised the goal to 95% for fiscal year 2000 and 100% for fiscal year 2001. DoD has shown the importance of operational dental readiness by raising the ODR standard to 100%. These issues are paramount in addressing my thesis questions.

A tool used since the late 1960's to measure a unit's level of dental readiness, ODR is critical in maintaining our military's overall level of operational readiness. In trying to find out the definition of ODR, I looked at the above SECNAV instruction and all it's references. Unfortunately, no definition was provided within the instruction or its references. I then looked at OPNAV, SECNAV and BUMED instructions. Unfortunately, I found nothing directly related to ODR. I did find a NDC Pensacola instruction titled, COMMAND OPERATIONAL DENTAL READINESS (ODR) PROGRAM, NDCPNCLAINST 6600.2F, but it was cancelled in September 2000. It was

cancelled because there was no equivalent higher authority instruction. I did find a definition in the Navy Dentistry's Performance Report 3rd Quarter, FY00. The report defines ODR as,

> The measure of Navy Dentistry's long standing principle mission is the minimal status of dental maintenance for active duty members to be operationally fit and is the foundation for achieving the ultimate outcome of "Dentally Healthy Sailors and Marines". (Quarterly Report, p. 6)

The Dental Corps assigns MDUs to NDCs serving large groups of operational forces, i.e. Norfolk, San Diego and Camp Lejeune. The Dental Corps currently has fifteen NDCs throughout CONUS and OCONUS. Of these fifteen NDCs, eleven have MDUs. MDUs are not traditionally purchased and assigned to areas where there are not large numbers of operational forces, i.e. Great Lakes, Pensacola.

2. Mobile Dental Unit Evolution

Although the Dental Corps and Navy Medicine did not start using Mobile Dental Units until the early 1990's, the concept of bringing dental care to the military member dates back to before the First World War. In the beginning of World War I, dental replacements were only authorized for teeth lost in the line of duty. This problem was compounded by the fact that no laboratory or prosthetic equipment was provided to combat divisions. This resulted in an urgent need for prosthetic equipment to avoid the unnecessary evacuation of injured personnel. Once solders realized they could be evacuated from the combat zone to receive prosthetic treatment, there was a dramatic increase in the willful destruction of dental appliances. This increased the demand for replacements. In a book titled, "United States Army Dental Service in World War II" by George F. Jeffcott, this retired dental corps officer states,

> Difficulties in providing adequate prosthetic care overseas resulted mainly from the fact that demands for dental appliances greatly exceeded all calculations. These factors were secondary, because more men than the Army anticipated required dental treatment upon entering, increasing the demand for initial and maintenance treatment. http://www.armymedicine.army.mil/history/booksdocs/wwii/dental/default.htm. p. 22 of 35)

Early mobile dental care can be traced back to at least 1918. In 1918, the Army authorized that damaged teeth, which caused the member to have difficulty with mastication, would be replaced. The Army established a dental field laboratory set to help carry out this new decree. This set weighed approximately two hundred pounds, cost three hundred dollars and was packed in a single chest. Prosthetic services were utilized on a small scale during World War I and this dental field set helped tremendously. In a parallel development, Operating Dental Trucks, which were not widely used until near the end of World War II, were used in a limited capacity during World War I. In 1917, the Cleveland Chapter of the Preparedness League of American Dentists suggested a project to construct a "dental ambulance" which would be presented to the Army in the name of the Red Cross. (See Figure 1.)

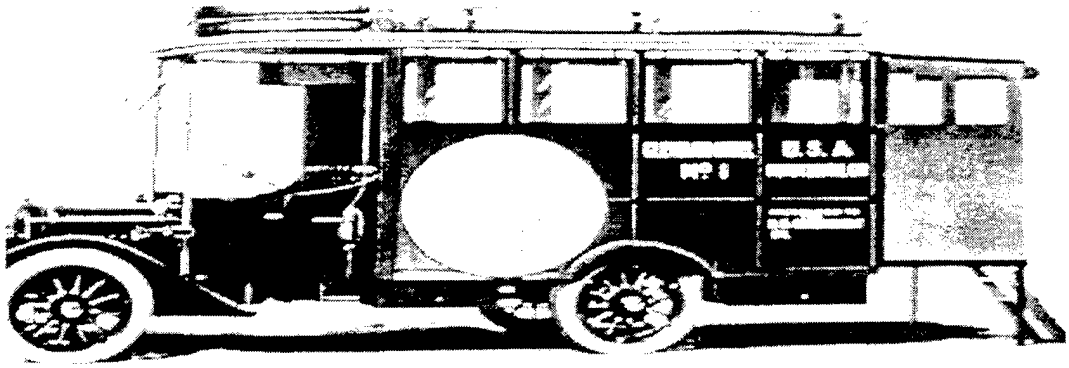

Figure 1. WWI Dental Ambulance.

During World War II, two dental field chests were introduced: Mobile Dental Chest number 61 and 62. These modified chests weighed more than the field sets and cost around six hundred dollars. Although these chests were mobile and were supplied to field hospitals, evacuation hospitals and surgical hospitals, they took considerable time to set up and were too small to carry the supplies needed for a prolonged emergency operation. In addition, these mobile dental chests and equipment needed water, fuel, power and light to operate. Depending on the location deployed, this often presented a problem.

The Army recommended that a more satisfactory alternative be initiated to alleviate this problem. In 1939, this initiative was the development of a truck mounted mobile dental vehicle. This vehicle was mounted on a six-wheel drive, two and a half ton chassis and was capable of navigating all but the roughest terrain. This vehicle carried a one and a half kilowatt generator, fifty gallon water tank, electrically heated boiling-out and curing apparatus, acetylene tanks, a folding dental chair, a dental engine, electric lathe and a full assortment of teeth and other needed supplies to complete a variety of work, including repairing dentures or bridges. (See Figure 2)

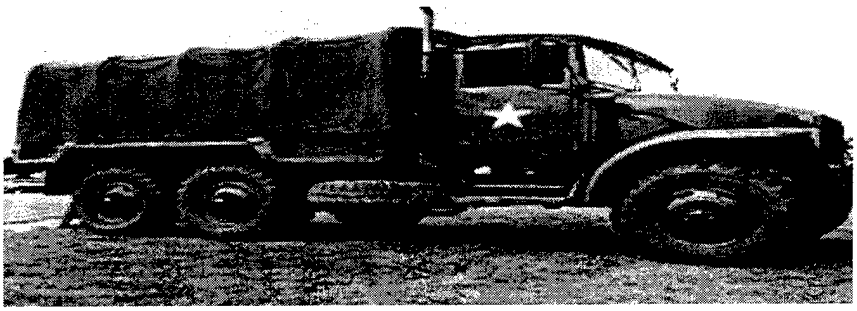

Figure 2. Frame of a Truck Mounted Mobile Dental Vehicle.

These mounted trucks served in a variety of configurations, including: Mobile Prosthetic Trucks, Mobile Dental Laboratories and Dental Operating Trucks. These vehicles went a long way toward addressing prosthetic problems during World War I and II.

Jeffcott goes on to state,

> Mobile dental trucks could function under any conditions, and by seeking out the patient saved an inestimable number of man-hours, which would otherwise have been consumed by patients traveling to a point where their needs could be met. (http://www.armymedicine.army.mil/history/booksdocs/wwii/dental/default.htm. p. 19 of 35)

Today, almost sixty years later, this is the cornerstone of why MDUs are used to support the fleet. Bringing MDUs pier side reduces the amount of time Sailors and Marines are away from their stations, increasing unit productivity and operational readiness.

Jeffcott also stated,

> Mobile operating trucks brought convenient basic equipment into the combat zone increasing the efficiency of dentists attached to tactical units. These trucks provided much needed support since many units did not have a dental officer and depended upon itinerant facilities for their dental care. (http://www.armymedicine.army.mil/history/booksdocs/wwii/dental/default.htm. p. 19 of 35)

The dental ambulance has come a long way since WWI. Today, these dental ambulances are called Mobile Dental Units. The MDUs purchased today are state of the art, self sufficient, and provide a variety of needed services. (See Figure 3)

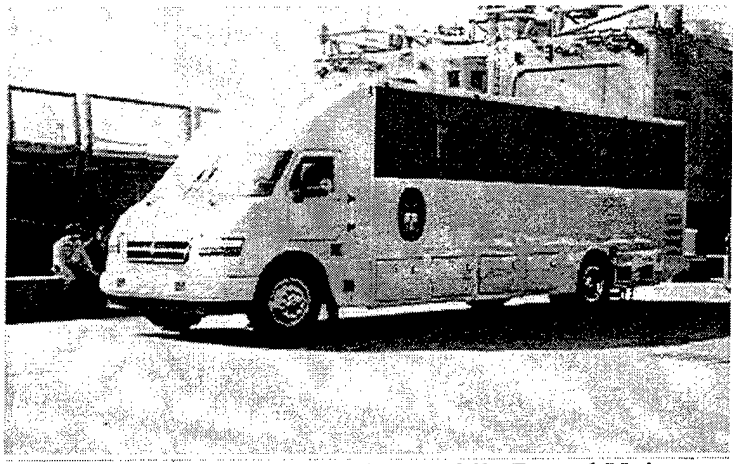

Figure 3. Present day Mobile Dental Unit.

Primarily through coordination of Naval Dental Centers Fleet Liaison Unit and each ship's medical department representative, MDUs play a major role in maintaining levels of operational dental readiness and quality dental health among the operational forces.

3. Phased Dentistry

Phased Dentistry is a concept that was introduced in the early 1990's to help sustain high levels of ODR. This concept was introduced in 1991 and later a pilot study was begun in 1992 and 1993 at NDC Orlando. The concept was approved in the fall of 1993 and implemented Navy wide. A paper titled MANAGED DELIVERY OF TOTAL QUALITY ORAL HEALTH, written by four dental officers in October 1994, explains the Phased Dentistry Concept. The paper states,

> Phased Dentistry is a concept of managed dental care that combines previously introduced initiatives in a synergistic manner in an effort to achieve optimal levels of readiness. It is a dynamic delivery system designed to achieve widespread and sustainable levels of ODR through active management of resources in response to real-time treatment needs. (Johnson, et. al., p. 1 of 10)

This concept has two phases. Phase One meets the Sailor's military requirements for operational dental readiness upon completing recruit training and 'A' school. This initial examination is the most important since it sets the stage for each individual's dental health and any future needed follow up care. Phase Two addresses the oral health care needs of the active duty service member upon reporting to their first duty station and assists in maintaining a high level of dental health while on active duty. This concept tracks and treats members from accession to retirement. Although, I have no documentation to validate the timelines governing this concept, they were substantiated in a telephone conversation with CAPT Joseph A. Draude, on the 8th of November 2000. CAPT Draude is currently the Deputy Assistant Chief for Navy Dentistry and has been in the United States Navy Dental Corps for almost thirty years.

C. ORGANIZATION

According to the National Archives and Records Administration, Records Relating to Personnel Participation in World War II: American Military Casualties and Burials,

> BUMED was established in 1842 and served as the Medical Service department for the Navy. BUMED is responsible for the maintenance of the health of Navy, Marine Corps personnel, for the care of the sick, injured, and dead and for related professional and technical training of Navy Department personnel. (National Archives and Record Administration, p. 7 of 36)

To assist BUMED, or more specifically, the Chief of the Bureau of Medicine and Surgery, with overseeing the Navy Medical Department, the Surgeon General has service chiefs for each corps and special assistants to help him oversee Navy medicine. The organizational structure of BUMED is depicted in Figure 4.

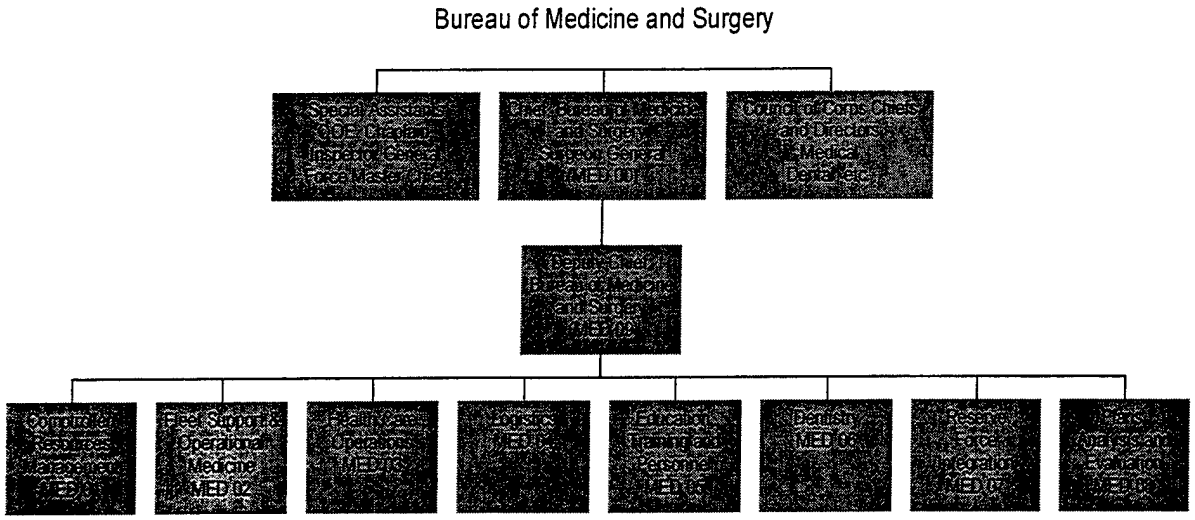

Figure 4. Organizational Chart of BUMED.

The Chief of the Dental Corps (OODC) and the Assistant Chief for Dentistry (MED 06) are within BUMED. The Dental Corps was established on the 22nd of August 1912 when signed into law by then President Taft. In June 1946, the Secretary of the Navy established the Dental Division (MED 06) within the Bureau of Medicine and Surgery. Today, one flag officer holds both titles and is responsible for overseeing all policies and issues affecting Navy dental personnel and providing the best quality dental care to the men and women of the United States Navy and United States Marine Corps.

The Dental Corps uses four delivery systems to take care of its beneficiaries. They are: Naval Dental Centers (NDCs), Branch Dental Clinics (BDCs), Dental Battalions and Mobile Dental Units. The United States Marine Corps and their Fleet Marine Force (FMF) units are the sole users of dental battalions. The Dental Corps presently has fifteen Naval Dental Centers throughout the world. Since each NDC is

responsible for certain geographical areas and the corresponding active duty population, BDCs or satellite clinics are placed in key locations to bring dental services closer to the service member. Naval Dental Centers, along with their smaller satellite clinics, are the principal organizations within the Navy's dental health care system. This reduces the need for service members having to go to one facility regardless of the distance. NDCSW has nine BDCs scattered throughout the west coast, from San Diego to Nevada. This assists NDCSW in providing dental support to the fleet and shore commands of the Pacific Fleet. NDCSW also services recruits from the Marine Corps Recruit Depot (MCRD) and Marine Corps Air Station (MCAS) Miramar. NDCSW was commissioned in September of 1967 and is the largest dental command in the Navy. The organizational structure of a major dental center is provided in Figure 5. The organizational diagram provided below was obtained from the Manual of the Medical Department (NAVMED P-117), Section 6-75 Definitions and Establishment.

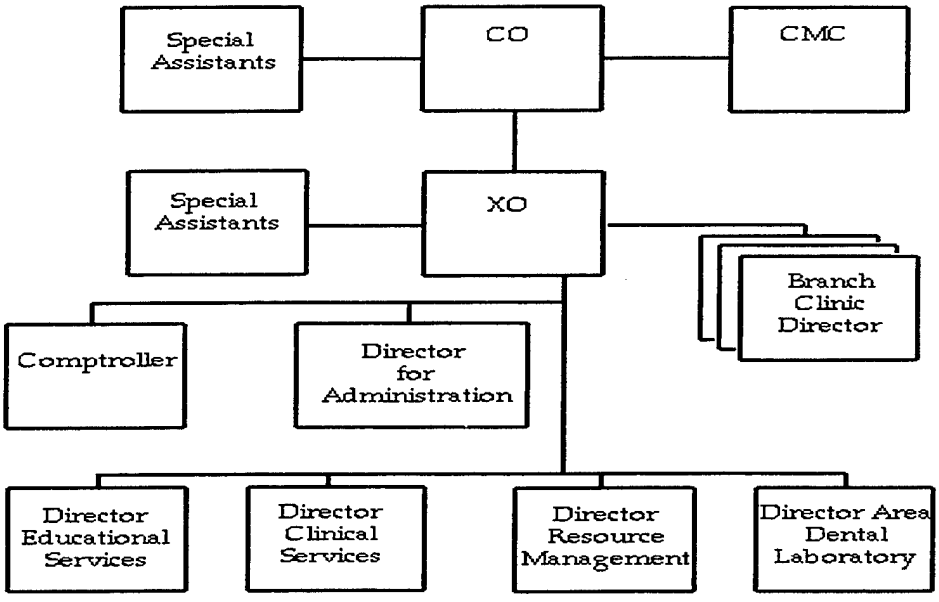

Figure 5. Organizational Structure of Major Dental Center.

Through the coordination of these organizations, polices, concepts and equipment, the dental health of Marines and Sailors are more than being adequately met. Utilization of these four delivery systems has allowed BUMED and the Dental Corps to achieve levels of ODR never before seen in the history of Navy medicine. Although the type of threats and future makeup of our military is uncertain, one thing is for sure: military forces must be ready to deploy at a moment's notice. Maintaining a high level of ODR will ensure dental healthy Sailors and Marines ultimately resulting in higher levels of operational readiness; so when the time does come, the Sailors and Marines will be ready to go.

III. ANALYSIS

The methodology used to answer the primary and secondary thesis research questions involve a combination of a Cost Benefit Analysis and Cost Effectiveness Analysis. Five metrics or measures will be used. They are:

- Metric 1: Average number of patients an MDU sees per day
- Metric 2: Number of days the MDUs were in operation during fiscal year 2000 and the first two months of fiscal year 2001
- Metric 3: Average time saved by seeing a patient at an MDU instead of sending the patient to a fixed facility
- Metric 4: Composite hourly wage rate of the "average" patient seen
- Metric 5: Utilization and Availability Rates for MDUs

Before going further into the analysis, I want to describe how the MDUs are currently deployed and briefly discuss each metric. Within Navy Medicine, or more specifically the Dental Corps, no optimal number of MDUs is presently identified for a Naval Dental Center. Any Naval Dental Center within the Dental Corps can request to purchase an MDU. A dental command requesting an MDU prepares a justification packet and submits it up the chain of command to MED 06, which is the ultimate approving authority for procuring MDUs. MED 06 also does the tech review upon receiving the justification packet. The procurement decision is based on necessity, which is articulated in the justification packet. If sufficient demand for MDU services exists and funding is available, the MDU is approved for procurement. Once approved, the request is forwarded to Naval Medical Logistics Command (NAVMEDLOGCOM) who initiates the requesition. The Army Proving Ground in Aberdeen, MD handles the

initiation of the contract. In past years another entity has initiated the contact but for Fiscal Years 00/01 it is the Army.

The ship or unit visited by an MDU is determined by the customer's needs. In this case, the majority of the customers come from the Pacific Fleet, local squadrons and Marine Corps Air Station (MCAS), Miramar. There are two key factors that determine the priority of MDU visits: deployment cycle and overall crew dental health. Ships either getting ready to deploy or returning from a deployment are given priority. Prior to a ship deploying, or upon return from a deployment, the ship's Medical Department Representative (MDR) contacts the Fleet Liaison Department of NDCSW. The Fleet Liaison Department contacts ships preparing to deploy three months prior to their departure. This allows both parties to work closely together resolving any dental issues and getting the ship to the DoD mandated level of ODR before they deploy. Identifying individuals who need an exam or treatment prior to departure decreases the likelihood of dental emergencies while underway, or of the sailors' classification codes degrading from a one or two to a three or four, causing the ship's ODR to drop. Ships that are returning contact the Fleet Liaison Department upon their return to the pier. The two departments again work closely identifying individuals requiring exams, cleanings or treatment and having dental classification codes of three or four.

The second consideration in MDU deployment is the crew's overall dental health. The dental health and dental class of each crewmember is tracked and maintained by a database within the ship's medical department. This list is provided to the Fleet Liaison Department. The crew's dental classes and the ODR level of each ship is an important factor in determining whether an MDU is needed. Deployment cycle and crew dental

health are combined in assigning priority to the thirty or so ships the MDUs support. For example, if a ship is getting ready to deploy and has a low state of ODR, they would be given priority over a ship with a higher ODR and who is not scheduled to deploy for sometime. Another case might be a ship getting ready to deploy and a ship just returning. The ship getting ready to deploy would have priority over a ship just returning. These two factors are critical in deploying MDUs.

These same factors address the issue of location of the MDU. The location of the MDU is determined by the customer with the greatest need. The thirty ships the MDUs support are all centrally located pierside at Naval Base San Diego. Therefore, it is not uncommon to see several MDUs on one pier servicing two or three different ships. In regards to FMF units, most come from Marine Corps Air Station (MCAS), Miramar. Ultimately, the need and location is determined by the Fleet Liaison Department with close coordination with respective medical departments in determining how these assets can best meet the dental health needs of each respective unit.

Although class three and four cases are the most serious and need to be resolved quickly, there is a new initiative to increase the fleet's percentage of dental class ones among are active duty forces. This initiative is called, Dental Health (DH). The premise behind this initiative is to provide our Sailors and Marines with the highest level of dental health possible. This is the Dental Corps ultimate goal. All dental care delivery systems, especially MDUs among the operational forces, will be utilized to achieve this goal.

MDUs are purchased primarily for two reasons. The MDU is either a new acquisition for the command or replacing an existing MDU that has outlived its lifecycle.

The lifecycle of an MDU is approximately ten years. If approved, MDUs are given three levels of priority: one, two and three. Priorities are given to identify which dental command receives their MDUs first. Giving each MDU a priority allows each requesting command to know when they can expect to receive their MDU and the fiscal year in which it was funded. Due to their expense and the fact that several NDCs may request an MDU in one fiscal year, not all MDUs are funded within the same fiscal year. The funding for MDUs, controlled by MED 01 and NAVMEDLOGCOM, also restricts the number of MDUs that can be purchased annually. On the 29th of January of 2001, I conducted a phone interview with Ms. June Danis who is the Investment Equipment Program Manager at NAVMEDLOGCOM. Ms. Danis explained to me that because of their expense only three MDUs are funded in any fiscal year. Presently, an MDU costs $248,000. This price also includes a two percent administrative fee which is paid to Aberdeen. Time between submission of request, approval, initiation of the requisition and contract and delivery can take up to a year before the NDC will see their MDU. Presently, NDCSW is scheduled to receive three new MDUs over the next three fiscal years to replace existing units. The first new MDU is tentatively scheduled to be delivered in April 2002.

A. METRIC 1: AVERAGE NUMBER OF PATIENTS SEEN PER MDU

In looking at metric 1, I was concerned with determining the average number of patients seen per day. I did this by collecting fourteen months worth of workload from the Fleet Liaison Department at NDCSW. Patients during this timeframe are broken into two categories; shore patients and ship patients. Although the MDUs see primarily ship patients, they also see patients from squadrons and Fleet Marine Force units, referred to

as shore patients. Adding together the two patient categories and dividing by the months used yields a monthly average. Days lost need to be accounted for before a daily average can be determined. Days lost includes days where there was no demand for the MDU or the MDU was out of commission for maintenance. The total number of patients seen by that MDU is then divided by the number of days the MDU was in service, resulting in a daily average number of patients treated by an MDU. Number of patients seen per day is critical in determining the savings generated by using MDUs and determining the optimal number of MDUs for NDCSW. It is impossible to determine the capacity of each MDU because capacity depends on the treatment provided the customer. The initial spreadsheet obtained from NDCSW is attached. (See Table 1)

B. METRIC 2: NUMBER OF DAYS THE MDUS WERE IN OPERATION

In looking at metric 2, I was concerned with the number of days the MDUs were in operation during the fourteen months of workload I had obtained. A few key points need to be made regarding this metric. Days over this fourteen-month period are broken into three categories: days available, days used and days lost. MDUs are only deployed on Monday through Thursday. They are not utilized on Fridays and holidays. Friday is used to refuel, restock and flush the tanks of the MDUs, so they are ready to go Monday morning. To better depict the usage rate of each MDU during this timeframe, I modified Table 1 using Excel to better show the average workload generated by each MDU, and by the four MDUs cumulatively. This modified table will be referred to as Table 2. These charts also help differentiate between down time due to maintenance or lack of demand. Separating lost days into these two categories will more accurately indicate the optimal number of MDUs for NDCSW. Note: The months analyzed for this thesis have different

days available because months have different lengths and different weekend days, Fridays and holidays.

FY	Month	MDU #	Days Avail	Days Used	Days lost	Ship Days	Shore Days	Ship Pts	Shore Pts	Util Rate
00	Oct	1	15	15	0	10	5	201	126	100.00%
00	Oct	2	15	7	8	7	0	150	0	100.00%
00	Oct	3	15	15	0	12	3	214	85	100.00%
00	Oct	4	15	15	0	12	3	250	81	100.00%
00	Oct	ALL MDUs	60	52	8	41	11	815	292	100.00%
00	Nov	1	16	10	0	10	0	232	0	62.50%
00	Nov	2	16	0	14	0	0	0	0	0.00%
00	Nov	3	16	14	0	10	4	243	143	87.50%
00	Nov	4	16	11	0	11	0	257	0	68.75%
00	Nov	ALL MDUs	64	35	14	31	4	732	143	70.00%
00	Dec	1	18	2	13	2	0	26	0	40.00%
00	Dec	2	18	8	0	8	0	184	0	44.44%
00	Dec	3	18	14	0	14	0	363	0	77.78%
00	Dec	4	18	3	14	2	1	35	25	75.00%
00	Dec	ALL MDUs	72	27	27	26	1	608	25	60.00%
00	Jan	1	16	14	0	11	3	185	130	87.50%
00	Jan	2	16	7	3	7	0	134	0	53.85%
00	Jan	3	16	12	0	12	0	259	0	75.00%
00	Jan	4	16	15	1	7	8	129	78	100.00%
00	Jan	ALL MDUs	64	48	4	37	11	707	208	80.00%
00	Feb	1	16	13	2	13	0	260	0	92.86%
00	Feb	2	16	11	0	11	0	198	0	68.75%
00	Feb	3	16	12	0	12	0	179	0	75.00%
00	Feb	4	16	8	8	8	0	137	0	100.00%
00	Feb	ALL MDUs	64	44	10	44	0	774	0	81.48%
00	Mar	1	18	18	0	18	0	287	0	100.00%
00	Mar	2	18	14	0	14	0	147	0	77.78%
00	Mar	3	18	10	3	10	0	119	0	66.67%
00	Mar	4	18	12	2	8	4	96	51	75.00%
00	Mar	ALL MDUs	72	54	5	50	4	649	51	80.60%
FY	Month	MDU #	Days Avail	Days Used	Days lost	Ship Days	Shore Days	Ship Pts	Shore Pts	Util Rate
00	Apr	1	16	8	4	8	0	118	0	66.67%
00	Apr	2	16	12	0	12	0	98	0	75.00%
00	Apr	3	16	16	0	16	0	220	0	100.00%
00	Apr	4	16	8	0	4	4	44	115	50.00%
00	Apr	ALL MDUs	64	44	4	40	4	480	115	73.33%
00	May	1	18	12	0	12	0	149	0	66.67%
00	May	2	18	10	4	10	0	193	0	71.43%
00	May	3	18	14	1	14	0	215	0	82.35%
00	May	4	18	18	0	14	4	194	144	100.00%
00	May	ALL MDUs	72	54	5	50	4	751	144	80.60%
00	Jun	1	17	12	0	12	0	254	0	70.59%
00	Jun	2	17	13	0	5	8	57	218	76.47%
00	Jun	3	17	17	0	13	4	134	55	100.00%
00	Jun	4	17	9	5	5	4	43	118	75.00%
00	Jun	ALL MDUs	68	51	5	35	16	488	391	80.95%
00	Jul	1	15	14	0	13	1	135	34	93.33%
00	Jul	2	15	5	10	5	0	133	0	100.00%
00	Jul	3	15	9	2	5	4	81	107	69.23%
00	Jul	4	15	12	0	10	2	196	62	80.00%
00	Jul	ALL MDUs	60	40	12	33	7	545	203	83.33%
00	Aug	1	19	11	0	8	3	147	116	57.89%
00	Aug	2	19	10	4	6	4	108	105	66.67%
00	Aug	3	19	12	0	12	0	274	0	63.16%
00	Aug	4	19	14	0	14	0	357	0	73.68%
00	Aug	ALL MDUs	76	47	4	40	7	886	221	65.28%
00	Sep	1	15	15	0	15	0	145	0	100.00%
00	Sep	2	15	6	7	4	2	45	82	75.00%
00	Sep	3	15	15	0	4	11	28	155	100.00%
00	Sep	4	15	14	0	3	11	53	74	93.33%
00	Sep	ALL MDUs	60	50	7	26	24	271	311	94.34%
FY	Month	MDU #	Days Avail	Days Used	Days lost	Ship Days	Shore Days	Ship Pts	Shore Pts	Util Rate
2001	Oct	1	17	11	0	11	0	213	0	64.71%
2001	Oct	2	17	10	7	6	4	125	41	100.00%
2001	Oct	3	17	10	4	6	4	127	100	76.92%
2001	Oct	4	17	14	0	10	4	237	36	82.35%
2001	Oct	ALL MDUs	68	45	11	33	12	702	177	78.95%
2001	Nov	1	17	6	2	6	0	71	0	40.00%
2001	Nov	2	17	17	0	17	0	110	0	100.00%
2001	Nov	3	17	14	0	2	12	30	152	82.35%
2001	Nov	4	17	15	0	15	0	297	0	88.24%
2001	Nov	ALL MDUs	68	52	2	40	12	508	152	78.79%

Table 1. Initial NDCSW Spreadsheet.

Utilization Statistics for Mobile Dental Units

Fiscal Year	Month & Calendar Yr	MDUs & Mo Totals	Days Available	Days Used	Maint Down Days	Days Not Used	Ship Days	Shore Days	Ship Patients	Shore Patients	Utilization Rate	Availability Rate	Ship Patients per Ship Day	Shore Patients per Shore Day	All Patients per Days Used	Total Patients
00	Oct 99	MDU 1	15	15	-	-	10	5	201	126	100.0%	100.0%	20.1	25.2	21.8	327
00	Nov 99	MDU 1	16	10	-	6	10	-	232	-	62.5%	62.5%	23.2		23.2	232
00	Dec 99	MDU 1	18	2	13	3	2	-	26	-	40.0%	11.1%	13.0		13.0	26
00	Jan 00	MDU 1	16	14	-	2	11	3	183	130	87.5%	87.5%	16.8	43.3	22.5	315
00	Feb 00	MDU 1	16	13	2	1	13	-	260	-	92.9%	81.3%	20.0		20.0	260
00	Mar 00	MDU 1	18	18	-	-	18	-	287	-	100.0%	100.0%	15.9		15.9	287
00	Apr 00	MDU 1	16	8	4	4	8	-	118	-	66.7%	50.0%	14.8		14.8	118
00	May 00	MDU 1	18	12	-	6	12	-	149	-	66.7%	66.7%	12.4		12.4	149
00	Jun 00	MDU 1	17	12	-	5	12	-	254	-	70.6%	70.6%	21.2		21.2	254
00	Jul 00	MDU 1	15	14	-	1	13	1	135	34	93.3%	93.3%	10.4	34.0	12.1	169
00	Aug 00	MDU 1	19	11	-	8	8	3	147	116	57.9%	57.9%	18.4	38.7	23.9	263
00	Sep 00	MDU 1	15	15	-	-	15	-	145	-	100.0%	100.0%	9.7		9.7	145
01	Oct 00	MDU 1	17	11	-	6	11	-	213	-	64.7%	64.7%	19.4		19.4	213
01	Nov 00	MDU 1	17	6	2	9	6	-	71	-	40.0%	35.3%	11.8		11.8	71
00	Oct 99	MDU 2	15	7	8	-	7	-	150	-	100.0%	46.7%	21.4		21.4	150
00	Nov 99	MDU 2	16	-	14	2	-	-	-	-	0.0%	0.0%				-
00	Dec 99	MDU 2	18	8	-	10	8	-	184	-	44.4%	44.4%	23.0		23.0	184
00	Jan 00	MDU 2	16	7	3	6	7	-	134	-	53.8%	43.8%	19.1		19.1	134
00	Feb 00	MDU 2	16	11	-	5	11	-	198	-	68.8%	68.8%	18.0		18.0	198
00	Mar 00	MDU 2	18	14	-	4	14	-	147	-	77.8%	77.8%	10.5		10.5	147
00	Apr 00	MDU 2	16	12	-	4	12	-	98	-	75.0%	75.0%	8.2		8.2	98
00	May 00	MDU 2	18	10	4	4	10	-	193	-	71.4%	55.6%	19.3		19.3	193
00	Jun 00	MDU 2	17	13	-	4	5	8	57	218	76.5%	76.5%	11.4	27.3	21.2	275
00	Jul 00	MDU 2	15	5	10	-	5	-	133	-	100.0%	33.3%	26.6		26.6	133
00	Aug 00	MDU 2	19	10	4	5	6	4	108	105	66.7%	52.6%	18.0	26.3	21.3	213
00	Sep 00	MDU 2	15	6	7	2	4	2	45	82	75.0%	40.0%	11.3	41.0	21.2	127
01	Oct 00	MDU 2	17	10	7	-	6	4	125	41	100.0%	58.8%	20.8	10.3	16.6	166
01	Nov 00	MDU 2	17	17	-	-	17	-	110	-	100.0%	100.0%	6.5		6.5	110
00	Oct 99	MDU 3	15	15	-	-	12	3	214	85	100.0%	100.0%	17.8	28.3	19.9	299
00	Nov 99	MDU 3	16	14	-	2	10	4	243	143	87.5%	87.5%	24.3	35.8	27.6	386
00	Dec 99	MDU 3	18	14	-	4	14	-	363	-	77.8%	77.8%	25.9		25.9	363
00	Jan 00	MDU 3	16	12	-	4	12	-	259	-	75.0%	75.0%	21.6		21.6	259
00	Feb 00	MDU 3	16	12	-	4	12	-	179	-	75.0%	75.0%	14.9		14.9	179
00	Mar 00	MDU 3	18	10	3	5	10	-	119	-	66.7%	55.6%	11.9		11.9	119
00	Apr 00	MDU 3	16	16	-	-	16	-	220	-	100.0%	100.0%	13.8		13.8	220
00	May 00	MDU 3	18	14	1	3	14	-	215	-	82.4%	77.8%	15.4		15.4	215
00	Jun 00	MDU 3	17	17	-	-	13	4	134	55	100.0%	100.0%	10.3	13.8	11.1	189
00	Jul 00	MDU 3	15	9	2	4	5	4	81	107	69.2%	60.0%	16.2	26.8	20.9	188
00	Aug 00	MDU 3	19	12	-	7	12	-	274	-	63.2%	63.2%	22.8		22.8	274
00	Sep 00	MDU 3	15	15	-	-	4	11	28	155	100.0%	100.0%	7.0	14.1	12.2	183
01	Oct 00	MDU 3	17	10	4	3	6	4	127	100	76.9%	58.8%	21.2	25.0	22.7	227
01	Nov 00	MDU 3	17	14	-	3	2	12	30	152	82.4%	82.4%	15.0	12.7	13.0	182
00	Oct 99	MDU 4	15	15	-	-	12	3	250	81	100.0%	100.0%	20.8	27.0	22.1	331
00	Nov 99	MDU 4	16	11	-	5	11	-	257	-	68.8%	68.8%	23.4		23.4	257
00	Dec 99	MDU 4	18	3	14	1	2	1	35	25	75.0%	16.7%	17.5	25.0	20.0	60
00	Jan 00	MDU 4	16	15	1	-	7	8	129	78	100.0%	93.8%	18.4	9.8	13.8	207
00	Feb 00	MDU 4	16	8	8	-	8	-	137	-	100.0%	50.0%	17.1		17.1	137
00	Mar 00	MDU 4	18	12	2	4	8	4	96	51	75.0%	66.7%	12.0	12.8	12.3	147
00	Apr 00	MDU 4	16	8	-	8	4	4	44	115	50.0%	50.0%	11.0	28.8	19.9	159
00	May 00	MDU 4	18	18	-	-	14	4	194	144	100.0%	100.0%	13.9	36.0	18.8	338
00	Jun 00	MDU 4	17	9	5	3	5	4	43	118	75.0%	52.9%	8.6	29.5	17.9	161
00	Jul 00	MDU 4	15	12	-	3	10	2	196	62	80.0%	80.0%	19.6	31.0	21.5	258
00	Aug 00	MDU 4	19	14	-	5	14	-	357	-	73.7%	73.7%	25.5		25.5	357
00	Sep 00	MDU 4	15	14	-	1	3	11	53	74	93.3%	93.3%	17.7	6.7	9.1	127
01	Oct 00	MDU 4	17	14	-	3	10	4	237	36	82.4%	82.4%	23.7	9.0	19.5	273
01	Nov 00	MDU 4	17	15	-	2	15	-	297	-	88.2%	88.2%	19.8		19.8	297
00	Oct 99	All MDUs	60	52	8	-	41	11	815	292	100.0%	86.7%	19.9	26.5	21.3	1,107
00	Nov 99	All MDUs	64	35	14	15	31	4	732	143	70.0%	54.7%	23.6	35.8	25.0	875
00	Dec 99	All MDUs	72	27	27	18	26	1	608	25	60.0%	37.5%	23.4	25.0	23.4	633
00	Jan 00	All MDUs	64	48	4	12	37	11	707	208	80.0%	75.0%	19.1	18.9	19.1	915
00	Feb 00	All MDUs	64	44	10	10	44	-	774	-	81.5%	68.8%	17.6		17.6	774
00	Mar 00	All MDUs	72	54	5	13	50	4	649	51	80.6%	75.0%	13.0	12.8	13.0	700
00	Apr 00	All MDUs	64	44	4	16	40	4	480	115	73.3%	68.8%	12.0	28.8	13.5	595
00	May 00	All MDUs	72	54	5	13	50	4	751	144	80.6%	75.0%	15.0	36.0	16.6	895
00	Jun 00	All MDUs	68	51	5	12	35	16	488	391	81.0%	75.0%	13.9	24.4	17.2	879
00	Jul 00	All MDUs	60	40	12	8	33	7	545	203	83.3%	66.7%	16.5	29.0	18.7	748
00	Aug 00	All MDUs	76	47	4	25	40	7	886	221	65.3%	61.8%	22.2	31.6	23.6	1,107
00	Sep 00	All MDUs	60	50	7	3	26	24	271	311	94.3%	83.3%	10.4	13.0	11.6	582
01	Oct 00	All MDUs	68	45	11	12	33	12	702	177	78.9%	66.2%	21.3	14.8	19.5	879
01	Nov 00	All MDUs	68	52	2	14	40	12	508	152	78.8%	76.5%	12.7	12.7	12.7	660
		Totals	932	643	118	171	526	117	8,916	2,433	79.0%	69.0%	17.0	20.8	17.7	11,349

Utilization of Mobile Dental Units • Summary

MDU #	MDU Days Available	MDU Days Used	Maint Down Days	Days Not Used	Ship Days	Shore Days	Ship Patients	Shore Patients	Utilization Rate	Availability Rate	Ship Patients per Ship Day	Shore Patients per Shore Day	Total Patients per Days Used	Total Patients
MDU 1	233	161	21	51	149	12	2,423	406	75.9%	69.1%	16.3	33.8	17.6	2,829
MDU 2	233	130	57	46	112	18	1,682	446	73.9%	55.8%	15.0	24.8	16.4	2,128
MDU 3	233	184	10	39	142	42	2,486	797	82.5%	79.0%	17.5	19.0	17.8	3,283
MDU 4	233	168	30	35	123	45	2,325	784	82.8%	72.1%	18.9	17.4	18.5	3,109
All MDUs	932	643	118	171	526	117	8,916	2,433	79.0%	69.0%	17.0	20.8	17.7	11,349

Table 2. Utilization Statistics for Mobile Dental Units.

C. METRIC 3: AVERAGE TIME SAVED BY PATIENT BEING SEEN BY AN MDU INSTEAD OF A FIXED FACILITY

In researching this issue, the primary reasons MDUs are used are twofold. First, they improve the dental heath of our active duty forces and increase ODR and operational readiness. Second, and most important, they play an invaluable role in getting the men and women in the operational forces back to work, which reduces non- productive time and increases unit productivity. In reviewing two recent justification packages submitted by Naval Dental Center, Norfolk and Naval Dental Center, Southwest for procuring additional MDUs, both commands estimated a two-hour savings when a patient is seen by an MDU instead of going to a fixed facility.

This estimate was validated by three interviews I conducted during my site visit to NDCSW, 3-6 November 2000. I interviewed CDR Greg Watford and two Independent Duty Corpsmen (IDCs) during my visit at NDCSW. CDR Watford is the Fleet Liaison Officer at NDCSW. The IDCs included Senior Chief Hospital Corpsman Espitia aboard the USS Valley Forge (CG-50) and Hospital Corpsman First Class Campbell aboard the USS Curtis (FFG-38). These IDCs are responsible for the medical and dental health of a crew of over three hundred. They both agreed that saving time is the biggest benefit the MDUs provide when scheduling dental exams or treatment for a crew of over three hundred. They also agreed that the two-hour time saving is an accurate estimation. Using charts again, I will show the cost savings to the Department of the Navy by sending a service member to an MDU instead of a fixed facility.

D. METRIC 4: AVERAGE COMPOSITE HOURLY RATE

When serving the fleet, the MDU sees service members from all pay grades, officers and enlisted alike. The predominant rank of the average patient seen is E-4. In trying to estimate the cost savings involved in treating these service members, the Dental Corps used a composite cost of $15 per hour for an E-4. The military service-wide composite pay rate is obtained through the Department of Defense Accounting Manual, DoD Instruction 7220.9-M. This composite rate includes more than just basic pay. This rate is based on a combination of taxable and non taxable pay, which includes: base pay, basic allowance for housing, basic allowance for subsistence, cost of a permanent change of station move, leave and holiday benefits and other personnel costs. The military uses this composite rate to better determine the cost of bringing an enlisted man or officer of a specific pay grade into the military or the cost to replace one in the event they leave. The rank of E-4, and its composite dollar amount, was also used by both NDCs in justifying their respective requests to obtain additional MDUs.

E. METRIC 5: UTILIZATION AND AVAILABILITY RATE

The utilization rate is used to identify and track the usage rate of each MDU. This rate currently does not consider days that the MDU is unavailable due to maintenance. By not taking into account this factor, the utilization rate is skewed. For the purpose of this thesis, I have created another rate, called the availability rate. This rate takes into account all down days, including days MDUs are not used due to insufficient demand and maintenance down days. The availability rate is depicted in the modified excel table entitled Utilization Statistics for Mobile Dental Units (See Table 2).

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IV. FINDINGS

The primary goal of this thesis is to determine the optimal number of MDUs for Naval Dental Center, Southwest, in San Diego, CA. I selected NDCSW for three reasons. First, it is close to the Naval Postgraduate School, second, it is the Navy's largest dental command within the Dental Corps and BUMED, and third, it has a total of five MDUs. In trying to answer this question, fourteen months worth of MDU workload was obtained and a site visit of NDCSW was conducted in December 2000. The workload identifies the number of patients, sea and shore, seen by each of the four MDUs during fiscal year 2000 and the first two months of fiscal year 2001. Although, fourteen months worth of workload was collected, the analysis will concentrate on fiscal year 2000 data since the variable costs in maintaining the MDUs are based on annual averages. Comparing similar timeframes will allow a better depiction of what the actual savings might be. This chapter will also provide findings regarding each metric identified and discussed in Chapter III.

A. METRIC 1: AVERAGE NUMBER OF PATIENTS SEEN PER MDU

MDUs saw over 11,349 patients over the fourteen-month period. Per MDU, that equates to an average of 2,837 patients. Taking the total number of patients seen and dividing it by the number of days used yields the average number of patients seen per MDU. An average of 17.7 patients was seen per day by each MDU. For the purpose of this thesis, I rounded the average to 18. Table 3 below shows the total number of patients seen per month during the fourteen-month period.

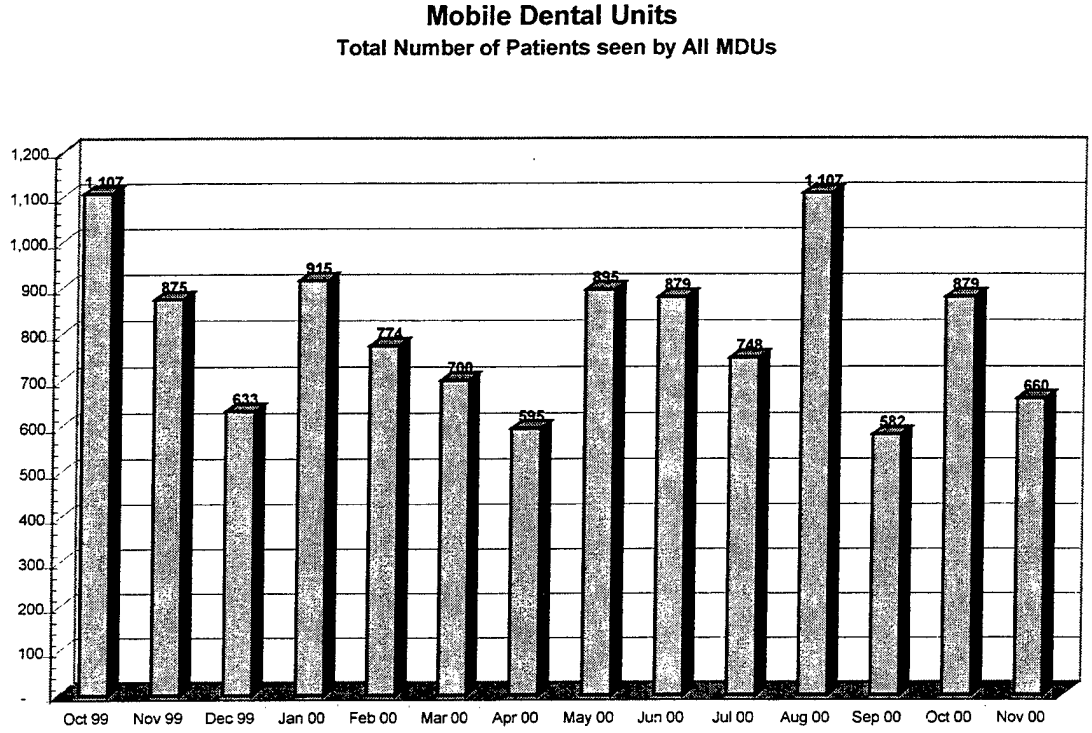

Table 3. Total Number of Patients Seen Per Month by All MDUs.

B. METRIC 2: NUMBER OF DAYS MDUS WERE IN OPERATION

There are two categories of days that need to be identified in determining the number of days the MDUs were in operation: days available and days used. The difference between the two is those days that the MDU was either down for regular maintenance or not used due to lack of demand. The importance of these two categories will be discussed in greater detail in Metric 5 of this chapter. Over the fourteen-month period, a total of 233 days per MDU were available. Again, this takes into account that MDUs are not utilized on Fridays, weekends and holidays. This totals to 932 days for all four MDUs.

C. METRIC 3: AVERAGE TIME SAVED BY PATIENT BEING SEEN BY MDU INSTEAD OF A FIXED FACILITY

I obtained copies of recent justification packets from the Navy's two largest Naval Dental Centers requesting additional MDUs: Naval Dental Center, Norfolk and Naval Dental Center, Southwest. Both packets assumed 2.3 hours were saved each time a patient utilized the MDU vice a fixed facility. I modified this hourly savings to two hours after my site visit to NDCSW. I did this for two reasons. First, NDCSW is within walking distance of where most of the ships are staged at Naval Base San Diego. Second, I interviewed three individuals regarding this issue. In discussing this with the three individuals, they agreed that two hours was a better estimation of time saved. For this reason, I modified the time saved per patient to two hours. I cannot comment on the timesavings for NDC, Norfolk. It is an entirely different base and the ships may be further away, justifying the additional half hour.

I also spent a morning with one of the MDUs during my site visit. There is no question that having the MDU on the pier right in front of the ships saves time. Getting the active duty member treated and returned to work quickly, in my opinion, is the most important benefit that the MDUs provide. The other factor that cannot be overstated is the increased level of dental health of our active duty forces and the increased state of operational readiness the MDUs bring to the fleet and the Navy and Marine Corps.

D. METRIC 4: COMPOSITE HOURLY RATE OF PREDOMINANT RANK

The average hourly pay rate and predominant rank was also obtained from the two justification packets previously mentioned. Both packets used the rank of E-4 at a rate of $15 an hour. This rate is specifically used for Department of the Navy personnel;

there are different composite rates for each of the four military services. Differences reflect that some pays are service specific; example, submarine pay, sea pay, diving pay, etc. The important questions are why the rank E-4 was used and how the dollar amount was determined. As to the issue of rank, the majority of the ships the MDUs support are CGNs, DD's, DDG's and FFGs. These ships have large junior enlisted population. Even though the MDUs support all pay grades on each ship, the average rank is likely an E-4.

The issue of the amount is another matter. $15.00 per hour reflects more than just basic pay. For example, basic pay for an E-4 over four years based on the new 2001 pay scale is $1,576.20 a month. Breaking this pay down further to an hourly rate gives you a range of $4.38 to $6.57 an hour. The difference is whether you use thirty days or twenty days as the denominator. The composite rate is a combination of taxable income as well as non-taxable income. The rate includes things like: basic pay, retired pay accrual, basic allowance for quarters, permanent change of station allowances, incremental and miscellaneous compensation. All these factors make up the composite rate.

The composite hourly rate is also based on 260 working days per year which equals 2,080 work hours annually (260 x 8). Dividing that value by twelve months gives you 173.3 hours per month, which is greater that the 168 hours a month used by Navy medicine. Finally, effective 1 Oct 2000, the composite rate for an E-4 went up to $19.67 an hour. The information regarding what makes up a composite rate and their respective values I obtained from researching on the Internet and visiting websites:

http://www.tradoc.army.mil/rfh/military_composite_rates_2.htm and

http://www.dtic.mil/comptroller/rates.

E. METRIC 5: UTILIZATION AND AVAILABILITY RATES

The Fleet Liaison Department at NDCSW tracks MDU use by what's called the utilization rate. Utilization rate is also used in determining a cumulative rate as well. This metric assists NDCSW and the Dental Corps in finding out how productive these assets are and how frequently they are being used. In the initial NDCSW spreadsheet, referred to as Table 1, the overall utilization rate over the fourteen-month period was seventy nine percent. This rate did not include days lost due to maintenance. Maintenance days in which the MDU was not on the NDCSW compound were not counted in determining the rate. By not counting these days, you are not accurately measuring the productivity level of each MDU.

In trying to understand how the system works and why these vehicles are kept at the Public Works Center (PWC) so long, I called PWC. PWC at Naval Base San Diego is responsible for the maintenance of all the MDUs. On the 5th of February 2001, I conducted a telephone interview with a Mr. Glen Wingert, who is the Heavy Mobile Equipment Inspector at PWC and has been working in that capacity for over 12 years. According to Mr. Wingert, the problem is a combination of several factors. To begin with, no two MDUs are the same even though the same manufacturer might make them; they are built in different years. Mr. Wingert also informed me that no manuals accompany these vehicles to assist with repairs in the event one goes down. In some cases, the equipment in the MDU is not made in the U.S, complicated by the fact that the equipment within the MDU is made by different manufactures. This delays getting the equipment repaired and getting the MDU back to NDCSW. These assets need to be returned in a timelier manner, thereby, allowing more patients to be seen and making

them more productive. Distinguishing between days lost due to maintenance and lack of demand allows you to specifically identify the cause of the lost day. Accounting for this gives you a more accurate accounting of exactly why each MDU was not being used.

To better account for lost days, I created a new rate, called availability rate. This new rate includes days lost due to maintenance. When you include the difference between the two causes of lost days, the availability rate decreased by ten percent to an overall rate of sixty nine percent, compared to the utilization rate of seventy nine percent.

The availability rate in Figure 6 shows that thirteen percent of the time, MDUs were down due to maintenance problems and eighteen percent of the time, MDUs were not being utilized due to lack of demand. Figure 6 also shows the breakdown when using the utilization rate which differs primarily in that maintenance down days are not included in the total.

Lack of demand has on occasion resulted from insufficient enlisted MDU manning at NDCSW. The Fleet Liaison Department is responsible for staffing and deploying the MDUs at NDCSW. Inadequate manning levels can preclude the MDUs from deploying. The Fleet Liaison Department must be manned at 100% to ensure maximum utilization of all MDUs. Although, the manning issue is not discussed in detail in this thesis, future research could determine the exact cause and possible resolutions regarding this issue. Combined maintenance downtime and days not used accounted for 289 days, almost a third, or thirty one percent, of the days available. That equates to over 5,202 potential patients that could have been treated.

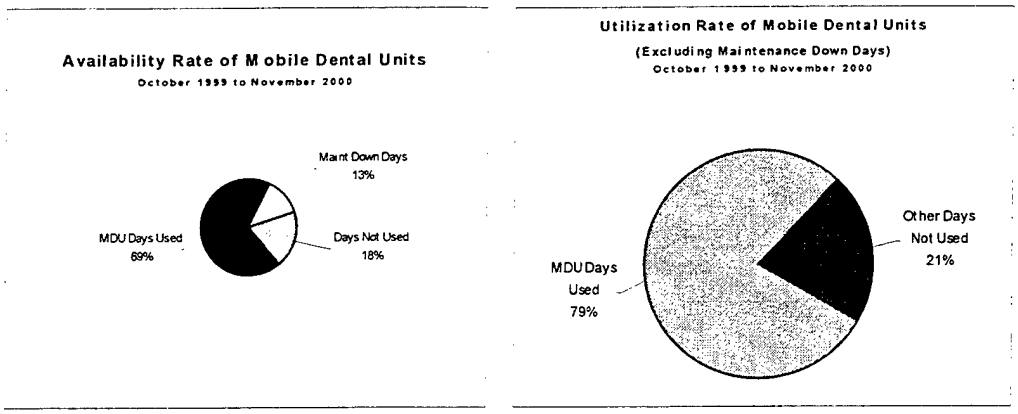

Figure 6. Availability and Utilization Rates of MDU.

During this fourteen-month period, each MDU saw an average of 2,837 patients. Treatment ranged from annual cleanings, annual exams, x-rays or replacing a filling. Again, MDUs only treat patients for these four core competencies, as discussed earlier in Chapter I.

Table 4 depicts the costs and man-hour savings generated by using MDUs in treating active duty members assigned to the operational forces at Naval Base San Diego and surrounding area.

1. Key Indicators (Based on fiscal year 2000 workload)

- Number of patients seen each day per MDU is 18
- Average number of days an MDU was available was 199 out of 366
- Average number of days an MDU was used was 137 out of 199
- Estimated hours saved per patient visit is 2.0
- Composite hourly rate of predominant rank (E-4) using MDU is $19.67

Note: (Rate is based on the new Military Composite Standard Pay Rate for the Department of the Navy for Fiscal Year 2001)

2. Man-hour Savings

- 18 patients/day/MDU x 1 MDU = 18 patients/day

- 18 patients/day x 199 days available (average) = 3,582 patients/year per MDU
- 18 patients/day x 137 days used (average) = 2,466 patients/year per MDU
- Difference between days available/days used = 1,116 patients/year
- 3,582 patients x 2.0 man-hours per patient = 7,164 man-hours/year
- 2,466 patients x 2.0 man-hours per patient = 4,932 man-hours/year
- Difference between days available/days used = 2,232 man-hours/year
- 7,164 man-hours x $19.67/hour = $140,916 annual savings per MDU
- 4,932 man-hours x $19.67/hour = $97,012 annual savings per MDU
- Difference between days available/days used = $43,904 loss/gain

Savings for 10 years (days available) per MDU = *$1,188,673*

Savings for 10 years (days used) per MDU = *$818,328*

3. Expenses

	ANNUAL	**10 YR DISCOUNTED**
Each MDU costs approximately	***$0.00***	***$248,000***
Average annual maintenance cost per MDU	***$2,301***	***$19,410***
Average annual re-supply cost per MDU	***$9,900***	***$83,510***
Total Expenses per MDU	***= $12,201***	***$350,920***

Table 4. Mobile Dental Unit (MDU) Man-hour Cost Savings Matrix.

Estimated Total Savings for 10 years (days available) per MDU = *$837,754*

Estimated Total Savings for 10 years (days used) per MDU = *$467,409*

Although an MDU is purchased in a specific fiscal year, the benefits of that purchase will be seen over a ten-year period. This is because the lifecycle of an MDU is 10 years. To accurately account for these savings and costs over ten years, I used a discount rate of .04% obtained from the Office of Management and Budget (OMB), Circular 4-94, Appendix C, January 2000. The discount rate is based on fiscal year 2000 dollars.

The variable costs associated with each MDU are annual. Therefore, only twelve of the fourteen months were used in determining days available and days used in determining savings and expenses. Table 3 only accounts for the expense of one MDU because NDCSW will only receive one annually, whereas they are funded each fiscal year to maintain all four. This is because presently, you have three different cost pools in trying to determine where the savings and expenses come from. Under the current system, MED 01, within BUMED, funds all MDUs. Annual re-supply and maintenance costs are the responsibility of NDCSW and each Naval Dental Center having an MDU. The Department of the Navy and DoD, not BUMED, or NDCSW will see the savings.

The Dental Corps has been purchasing MDUs regularly since 1988. The savings generated by these vehicles will ensure that MDUs will continue to be purchased over the next several years in an effort to maintain a high state of Operational Dental Readiness among the operational forces and increasing the overall Dental Health of are active duty population in the San Diego area.

Although the savings generated by these MDUs are substantial, they could be even larger. The issue is trying to determine the optimal number of MDUs.. Table 5 show when an additional MDU should be purchased. Table 5 depicts the ten-year lifecycle cost and savings of an MDU as the number of patients seen per year by the MDU increases. From a cost benefit perspective, the breakeven point indicates that an additional MDU should be considered if there is enough demand available within the San Diego geographical area for an MDU to treat an additional 1100 patients. (See Table 5).

Findings from the Cost Benefit Analysis and Cost Effectiveness Analysis in trying to determine what the optimal number of MDUs be will be presented in Chapter 5. Conclusions and recommendations will also be provided in Chapter 5.

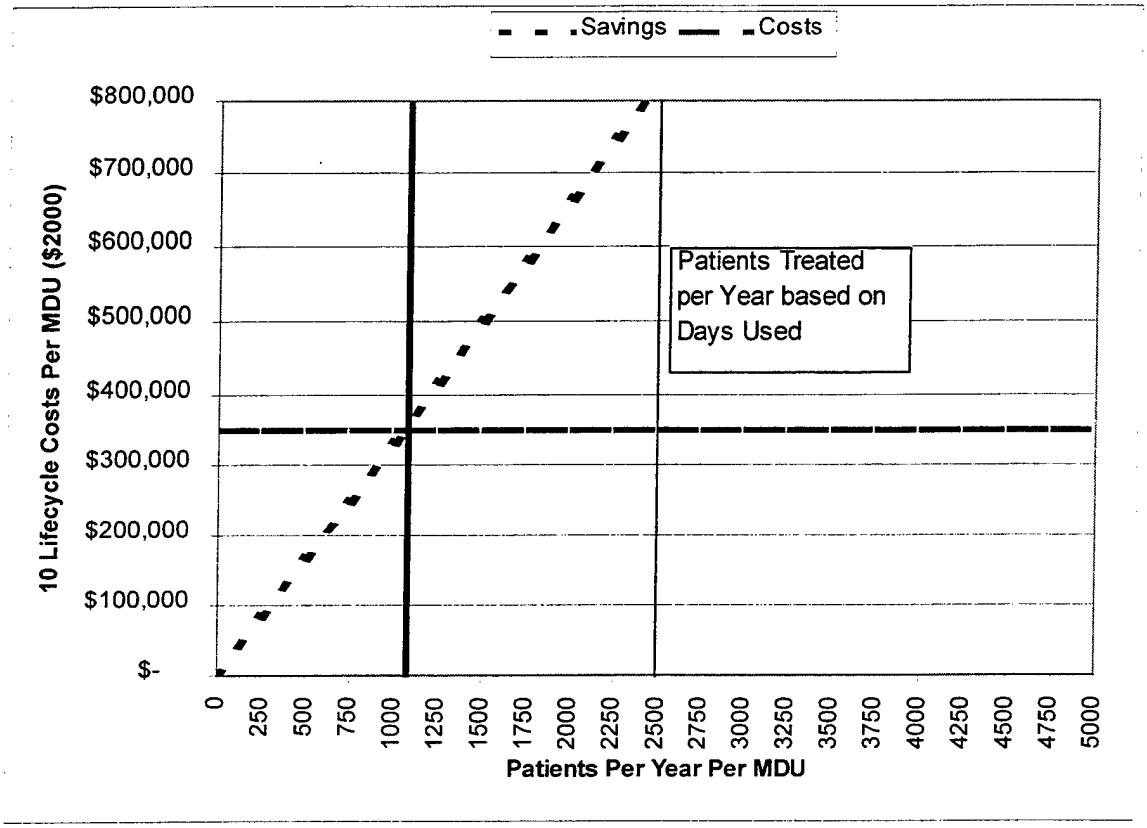

Table 5. Breakeven Analysis for Purchasing an MDU.

V. CONCLUSION AND RECOMMENDATIONS

A combination of two methodologies was utilized in attempting to answer the primary question of this thesis. The metrics discussed in chapter 3 will be used to present the findings from a cost effectiveness standpoint, while Table 4 and Table 5 within Chapter 4 will assist in looking at the findings from a cost benefit analysis perspective.

A. COST EFFECTIVENESS ANALYSIS FINDINGS

Comparing the number of patients treated to the days the MDUs were being used suggests that NDCSW could function with one less MDU to service the Pacific Fleet and the outlying San Diego, Ca. area. A couple of factors need to be mentioned before making any further conclusions regarding this issue. Normally three MDUs are scheduled with the fourth used in the event one goes down. This reflects the fact that an MDU could go down at any time and that typically there is not enough demand to support all four MDUs. Infrequently there is sufficient demand to support 4 MDUs at one time, but normally there is not. In the event one MDU breaks down, the fourth is used to replace it. There is no specific MDU designated as the backup. Whichever one is not being used is deployed in that capacity.

As shown in Figure 6, MDUs were not being used for one reason or another 31% of the time. One could conclude that an MDU will break down regularly, or not be deployed for an indefinite period of time. If NDCSW only had three MDUs, and one broke down, or there was a peak in demand for dental services, their ability to service the ships and other customers they support at Naval Base San Diego and MCAS Miramar could be severely diminished. This could negatively impact dental health among the 30

ships, squadrons and FMF units that they support, compromising the DoD mandated operational dental readiness levels of 95% required for operational readiness on each ship and across the Pacific Fleet. The fourth MDU gives NDCSW flexibility that they would not have with three MDUs. Taking all these issues into consideration, I believe that four is the optimal number of MDUs to service the Pacific Fleet. The deployment schedule for the four MDUs to best serve the customer should be determined by the Fleet Liaison Department. The unit or ship with the greatest demand or need should get the MDU. Key indicators in making that determination would be overall dental class of the ship, ODR level and deployment schedule.

B. COST BENEFIT ANALYSIS FINDINGS

Surprisingly, the findings from the cost benefit analysis appear to come to a different conclusion. Table 4 clearly shows that MDUs reduce the amount of lost man-hours by allowing the active duty member to seek treatment pier side. Savings are generated by the member being at work and not in transit to a fixed facility.

As depicted in Table 4, the savings reflect the estimated timesaving of two hours per patient, multiplied by the composite hourly rate of an E-4. Depending on whether you use days used or days available, the net savings are in the range between $467,409 and $837,754 per MDU over their ten year lifecycle. Clearly, the benefit (savings) MDUs generate exceeds their purchase price and annual maintenance and re-supply cost. Therefore, one could surmise that NDCSW should have additional MDUs.

This conclusion could be supported to a point. This point is the breakeven point, as in Table 5. Table 5 shows that as long as an MDU can see 1100 patients per year, another MDU would provide a positive net savings. Table 2 uses annual averages to

clearly show that an MDU has the capacity to treat 1100 patients. The issue not addressed is whether there is enough demand to justify a fifth MDU, or even a fourth MDU, when currently we know that they are not being used 18% of the time due to lack of demand. There is also the issue of should another MDU even be considered since ships are deploying with the minimum ODR level. The marginal data needed to make that determination does not exist. The data used for this thesis was MDU workload collected over 14 months and then averaged across four MDUs. There is the additional complication it is impossible to distinguish between days not used due to lack of demand and days lost due to lack of manning, infrequent as it may be. To make that determination, the data gathered would need to be separated between the two categories. Tracking the demand of the customers MDU support over a period of months or even annually would also be extremely helpful to better reflect future demand levels.

C. APPARENT CONTRADICTION

One could conclude that we have two conflicting results. One-analysis leads one to believe NDCSW could do with one less MDU; the other that they could do with more MDUs. As stated earlier, the only way to rectify the findings would be to get marginal data to determine the incremental impact of only having three MDUs compared to the additional demand satisfied by the fourth MDU. If not justified by the cost benefit analysis, a fourth MDU could still be justified for back-up (insurance) purposes. This justification would need to examine the expected dental readiness implications of only maintaining three MDUs without a backup when one breaks down with the data currently available. Data for either of these scenarios does not presently exist. Presently, the

analysis of the data indicates that the available MDUs met 100% of their customers needs simultaneously having 31% down time.

D. CONCLUSION

Although there is an apparent contradiction, which cannot be quantitatively resolved, a conclusion can still be formulated based on the facts and the data that is currently available. They are as follows:

- Dental Health and Operational Dental Readiness is of paramount concern to the Dental Corps, the Pacific Fleet and the Bureau of Medicine and Surgery
- On average, Mobile Dental Units currently save countless man-hours and generate a substantial cost savings over their ten-year lifecycle.
- Although there are some ineffectiveness issues that need to be addressed, over the 14 month period studied here, the average ODR level was 96% for the approximately 30 ships MDUs support in NDCSW, meeting the DoD mandated level of 90% ODR for fiscal year 2000 and 95% for fiscal year 2001
- To maintain high levels of ODR when facing maintenance down time, potential surges in demand, manning problems and dental health index, having four MDUs provides NDCSW more flexibility than just maintaining three MDUs, and increases the likelihood of meeting all the expected and unexpected requirements listed above.

NDCSW has an opportunity to gather the data required to determine the optimal number of MDUs for a relatively minimal cost. First, NDCSW could determine the workload three MDUs would generate compared to the demand served by four MDUs. Early next year NDCSW is to receive a new MDU to replace one of the older units. If they retain the older MDU, which they might due, they could determine the demand for dental services with five MDUs. Having actual workload on the productivity of three, four and five MDUs would go a long way to reaching a more accurate conclusion regarding exactly what the optimal number of MDUs should be.

The issue of continued savings is one that will be seen for years to come. MDUs have been purchased regularly since 1988. BUMED and NAVMEDLOGCOM anticipate continuing funding for these valuable assets through at least FY 2004. The issue of procuring additional units after this point in time will be determined by the condition of the existing fleet of MDUs, funding availability and need.

E. RECOMMENDATIONS

The issue of MDUs not being used 31% of time needs to be addressed. Regardless of whether it reflects maintenance down time or lack of demand/inadequate manning, there is room for improvement. Future MDUs need to be similar in design. Having the MDU come with operating manuals and specifications on repairs, like wiring chassis, generators and leveling systems or hydraulics, would be extremely helpful to PWC and help return the unit to NDCSW in a more timely manner. Standardizing different pieces of equipment within each MDU would also be extremely helpful.

The issue of manning needs to be addressed. Navy Medicine exists to support the fleet and provide quality medical and dental care to all active duty members and qualified beneficiaries. Historically, dental commands are designed and resourced to provide services in fixed facilities. The budget, staff and infrastructure all support that perspective. This philosophy is a contributing factor to the manning problem. Providing services through MDUs detracts from the "inpatient" delivery system. It is not clear how the continuum of customers and their needs are assessed and prioritized when allocating limited resources. Review of the process to access and prioritize customer needs may be an area for future research. Monitoring the demand for these vehicles and improving upon existing measures of effectiveness would also be helpful.

The Fleet Liaison Department must be manned at adequate levels to ensure that if an MDU is up and running, it can be manned and ready to deploy. This is even more important if older models that would normally be replaced with newer models are maintained to meet the Dental Health Index goals of future fiscal years.

Finally, MDU data should include maintenance down days in the utilization rate. Otherwise, the rate does not truly reflect their productivity. Not counting the maintenance down days generates an MDU utilization rate that is not accurate. If these days are accounted for, it will add importance to working with PWC to get these units back in a timelier manner, especially when each MDUs utilization rate depends on the days they are available to be deployed. Ultimately, we want these assets to be used as efficiently and effectively as possible, and we want to accurately reflect that productivity.

In August of 1993, then President Clinton signed the Government Performance and Results Act into law. The act was established to fundamentally change the way government programs and operations are managed and administered. Although the minimum ODR for our operational forces are being met, I believe we can make the MDUs more productive than they already are, resulting in additional annual savings and improving upon the ultimate goal of the Dental Corps; "Dental Healthy Sailors and Marines."

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